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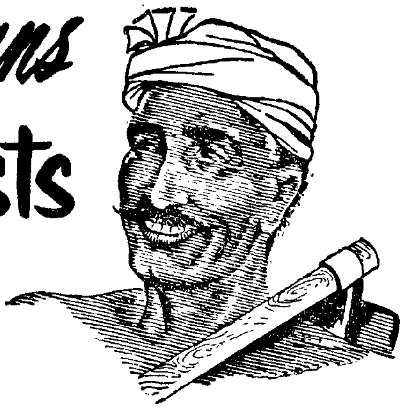

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The Madras Agricultural Journal

Vol. XLI December 1954 No. 12

Editorial

A Silver Jubilee: The Indian Council of Agricultural Research founded in 1929 on the recommendation of the Royal Commission in Agriculture has completed its twenty five years of useful work. The completion was marked by the celebration of the Silver Jubilee on the fourteenth of this month. We convey our hearty greetings on this momentous occasion.

Agricultural Research in India and in Madras is many years old. Dating back to 1871 when a small beginning was made at Saidapet, research in Agriculture had progressed to a considerable extent in the country. By 1928 a need came to be felt for coordination and organisation of the many research programmes that were being carried out in the different Research Institutions of the country. It was also felt that such coordination could increase the usefulness of the research and decrease its cost, which is very necessary in a country like ours where resources for research have largely to depend on Government munificience. In countries like the United States and England, research is backed not only by Government bodies as is the feature in this country but is predominently the concern of many enlightened firms, who subsidize research at Universities and Research Centres. This way, the tax payers, support to research through the Government sponsored organisations, is not only augmented but is also highly enthused by the interest evinced by the leading business magnates of the country. Our country has yet to stimulate this sort of interest in our leading financiers.

However, inspite of the limited resources at its disposal the Indian Council of Agricultural Research has succeeded in bolstering up research in this country. Much more than its financial backing to research we would put down as its greatest achievement the much needed planned outlook, which it has brought to bear on problems of research and its progress in this country.

We are proud of this occasion and proud to associate ourselves with this celebration of the Indian Council of Agricultural Research Silver Jubilee, as we in our own humble way have helped and contributed in the dissemination of the fruits of this planned research to our farmers through our pages.

Change of Office-Bearers: Consequent on the transfer of Sri. F. L. Daniel as Compost Development Officer, the Managing Committee has co-opted Sri. P. Madhava Menon, Assistant in Millets as Secretary and Sri. J. Sakharama Rao, Assistant in Botany as Treasurer vice Sri. M. V. Jayaraman proceeding on leave.

Marketing Supplement: We are glad to announce that from the next issue onwards the Madras Agricultural Journal will carry a Marketing Supplement which will contain matter specially contributed by the State Marketing Committees.

Our Cover: The picture on the cover page should be familiar to the old students of the Agricultural College. It shows the students of the College learning practical Agriculture. With a view to giving a new look to our journal, we propose to have different pictures in future on our cover page and in this we need the co-operation of our members. Photos blocks which may be of interest to our readers are invited for printing in our cover pages of the ensuing issues of the Madras Agricultural Journal.

Advances in Fertiliser Production and Use*

by

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One of the outstanding achievements in the field of Agriculture during the last one hundred years is the progress made in fertiliser production and use. Since the time Justus Von Liebig stressed the importance on plant nutrients and placed his patent manure on the market 110 years ago, scientists and manufacturers, the world over have probed into the problems of plant nutrition and nutrient supplies. Most famous are the studies at Rothamstead and Woburn in England, those of Wagner and Maercker in Germany, and those in the various states of the U. S. A. and in Pusa and Coimbatore in India. They have contributed a wealth of information on many phases of fertiliser production and fertiliser use in relation to soils and plant growth. This has resulted in the development of an industry of world-wide significance as an important branch of the chemical industry.

Early History: Even though the fertiliser industry occupies an important place today, until as late as 1940, fertiliser production was largely a byproduct subsidiary of the chemical industry. The era of cheap food prices till then, necessitated the sale of fertilisers at very cheap prices. Necessarily therefore, the fertiliser industry had to a substantial extent continue to be broadbased upon the by-products of other industries. The question then was whether any new process exclusively designed to produce a fertiliser suited to specific soil needs will ever hope to compete with the established byproducts of certain industries.

But with the departure of the cheap food era, the peculiar agricultural cum chemical background of the fertiliser industry is fast disappearing. Fertiliser consumption has expanded rapidly as can be found in the figures furnished in the subsequent paragraphs. A period of active technical development has now begun. Fertilisers are not just byproducts now, but have become largely specialised, and are produced and shaped to suit the needs of farmers in relation to their soil and the equipment used to apply them. Special methods of processing to facilitate easy application, the evolution of more specialised forms for increasing efficiency in

* Paper read at the College Day and Conference, 1954.

use, the production of better and cheaper types; are some of the lines on which the industry is bestowing more attention today.

Trends in Fertiliser Consumption: A review of the fertiliser situation during the last one hundred years would show that the industry did not make much progress in its early years of the twentieth century, farmers in some advanced countries had started using fertilisers in a small way. The American picture is quite revealing in this matter. As the largest consumer of fertilisers in the world today the United States of America reflect in a real manner the trends of fertiliser consumption. At the beginning of the century, the annual consumption of fertilisers there was only two million tons, while it is over twenty million tons today; a ten-fold increase. The British picture is more or less, quite similar. The real situation in regard to fertiliser consumption of other countries is rather misleading as disturbances of the war cut off their normal production and supplies. For instance, the high fertiliser consumption of several European countries dropped sevearly during the war years.

Looking at the Indian picture, we find that fertiliser consumption on any Substantial scale began only during the period of World War I. But rapid strides have been made in the development of the industry during the last decade. The war years witnessed a quick expansion in the consumption of fertilisers as also in their production. From a low of 30,000 tons during the thirties largely as a byproduct of the coke industry and the Belagula synthetic nitrogen factory in Mysore, ammonium sulphate production expanded more than ten times and very soon it is expected that production will touch half a million tons. Two new factories were set up, one in Alwaye, Travancore and another in Sindri. The first five year plan envisages a production of 4,60,000 tons of ammonium sulphate and 1,76,000 tons of superphosphate in addition to the 50,000 tons of bone meal produced in the country. Alongside of the increased production and consumption, we witness a marked change in the pattern of consumption of fertilisers. During the earlier years, the consumption was largely limited to the plantations and the hill crops like potatoes. This pattern has now changed and the largest consumer now possibly is the rice farmer. The price situation of agricultural commodities has done more to change the pattern of fertiliser consumption than anything that has happened during the last four thousand years.

The Supply Position: *Nitrogen:* Until World War I, the source of supply of this plant nutrient was partly ammonia, a byproduct from coke ovens, and partly nitrate from the South American nitrate deposits. These supplies were soon found inadequate, but by this time the fixation methods of atmospheric nitrogen had been perfected and between 1918 and 1930, the process was firmly established. Indeed by 1930, three quarters of the world's needs of fertiliser nitrogen were produced from the air. By 1939, Europe, where the fixation industry established itself first, was not only self supporting but was exporting large quantities to the outside world, with Germany as the largest producer. The United States of America was then largely an importer, but rapid strides were made during the forties in that country to make up the deficit. Many nitrogen fixing units were established during World War II mainly for the production of explosives but after the war was over, these were switched over to fertiliser production. The world production in 1950 of fixed nitrogen was to the tune of 2½ million tons.

Phosphorus: The main source of the world's fertiliser phosphorus is the various deposits of rock phosphate which are largely found in North America, United States of America, U. S. S. R., Dutch West Indies and Oceania. Some of these latter deposits were damaged during the war but are being rapidly rehabilitated. Annually about twenty million tons of rock phosphate are mined and utilised in the manufacture of various products, chief being the fertiliser superphosphate. Most of these flour-apatites are made available with sulphuric acid and until the time of World War II, the acid superphosphate process was a means of utilising the surplus sulphuric acid production which existed then in many countries of the world. There was therefore, considerable international competition in the disposal of this surplus acid which led to enormous price cuts in the superphosphate fertiliser scales. But this picture has now changed. What with the shortage of world sulphur supplies and the use of sulphuric acid in other more profitable directions, superphosphate today is selling at three to four times the prewar price.

The positition in this country in regard to phosphate supply is extremely difficult. Supplies of sulphur have to be largely imported. In regard to rock phosphate also the mineral has to be entirely imported. In India unfortunately, no supply of phosphate rocks has been within her terrain so far, barring the Tiruchirappalli nodules found in that district. These nodules have not been exploited to any extent and therefore an urgent need exists for

exploitation of this phosphate deposit. The application of finely powdered rock phosphate as such, in some of the acid soils is worthy of further experimentation as it is reported that this method is finding favour in the coconut and tea areas of the west coast, and also in Ceylon. It is for consideration, whether the nodules could not be processed into a fine form and made available for such direct application.

Other sources of phosphatic fertilisers in India are bone meal and a little of basic slag. The latter is confined to the very small and insignificant output from the iron industry. Bonemeal on the other hand is an important source and it has been estimated that the annual available supplies would amount to about 60,000 tons. A large portion of the bonemeal is however exported as the unit value of the phosphorus from bonemeal is relatively high compared to that from the mineral superphosphate and therefore the latter is a cheaper source of phosphorus.

Potassium: Potassium is another major plant nutrient essential to plant growth. Under the tropical climatic conditions obtaining in India however, the soils are subject to intense weathering, thus liberating adequate quantities of potassium which forms a substantial portion of the soil mineral matter. The soils in India are therefore generally well supplied with potash reserves, excepting possibly the laterites. Consequently, manurial experiments with nitrogen and phosphorous have not given significant results in crop production except possibly in the case of some special crops like tobacco, chillies, potatoes and groundnut. Potassium shortage may possibly arise only under intensive cropping conditions where the natural speed of weathering may not keep pace with the removal of potassium by the growing crops.

But elsewhere in the world, potassium plays an active part as an essential plant nutrient. Potassic fertiliser consumption trends indicate that its use has considerably expanded in recent times. From a low of 68,000 tons in 1880 the consumption touched a high of 28,80,000 tons by 1940 and to about for million tons by 1950. Upto the period of World War I, potash supplies were a German monopoly but the war experiences forced other countries to develop alternate sources. Today, potash deposits are extensively worked, not only in Germany but the United States, the U. S. S. R., France, Spain and Palestine. Large potash deposits are reported to have been located in Canada recently.

Analysis of consumption trends: Analysis of the figures of consumption of the three important plant nutrients give some interesting information in regard to the emphasis laid on one or the other nutrient in different countries.

Consumption of plant nutrients, 1950 :

Continent	in 1000 tons N	P_2O_5	K_2O	Ratio of plant nutrients N	P_2O_5	K_2O
Europe	1,641	2,367	2,380	1	1·44	1·45
North America	996	1,999	1,094	1	2·01	1·10
South America	65	75	21	1	1·15	0·32
Asia	567	320	139	1	0·56	0·25
Africa	117	149	34	1	1·27	0·29
Oceania	11	475	12	1	26·29	0·67
Total	3,405	5,386	3,681	1	1·58	1·08

The above figures of consumption are revealing in regard to the emphasis placed in the use of phosphatic fertilisers the world over excepting in the continent of Asia. In North America, the P_2O_5 application is more than double that of N and K. In Europe also, the extent of P_2O_5 use is greater than N. It is only in Asia that we find that the P_2O_5 application is less than that of N. In our country, we lay equal or sometimes more emphasis on Nitrogen than on P_2O_5. How far this tendency has to be modified the future alone could prove, but if world experience is a guide, the rate of application of P_2O_5 may have to be soon stepped up.

In the earlier sections, the trends of fertiliser consumption in various countries were given. But a proper comparison of fertiliser consumption can be made only by relating the consumption to the respective cultivated acreages. The following data from the Food and Agricultural Organisation relating to some countries of the world are interesting.

Consumption of fertilisers – (1946) :

	Lb. per acre of arable land N	P_2O_5	K_2O	Total nutrients
World average	2·9	4·5	2·4	9·8
Holland	56·0	92·0	90·0	238·0
Belgium	40·0	62·0	48·0	150·0

	Lb. per acre of arable land			
	N	P_2O_5	K_2O	Total nutrients
Germany	26·5	26·0	44·0	96·5
United Kingdom	9·0	31·0	13·5	53·5
Denmark	13·5	22·0	11·0	46·5
France	7·0	15·5	11·5	34·0
U. S. A.	2·5	5·0	2·6	10·1
Canada	0·6	1·4	1·0	3·0
U. S. S. R.	0·6	1·7	0·7	3·0
India (anthor's estimate)	1·0	0 3	0·1	1·4

It is seen that there is a high level of fertiliser consumption in some of the densely populated regions of Europe. Where the pressure of population on land is great, an intensive system of farming with high doses of fertiliser application have come to be evolved. This is possibly a lesson to India. Our agricultural output can be increased only by larger and larger applications of fertilisers.

Advance in fertiliser manufacture: It was mentioned earlier from a technological point of view, fertiliser production did not keep pace with the other segments of the chemical industry. Compared with the other processing industries such as synthetic rubber, rayon and plastics, fertiliser production was till recently woefully behind in the adoption of modern processes. Revolutionising developments are however now taking place in the industry.

Recent advances in fertiliser technology are directed towards (1) improving the availability of the various plant nutrients in relation to the soil conditions and plant growth, (2) in reducing costs of production, (3) in increasing nutrient concentrations to reduce handling costs, and (4) in evolving newer forms for better and efficient application. Some of these developments are considered below.

In the nitrogen field, developments have taken place largely in the use of new fertiliser materials like ammonia gas, ammoniacal liquids, urea and ammonium nitrate. Each has its own advantages and is suitable to certain favoured conditions. Recent interest has turned to the production of nitrogen materials of low water solubility. Outstanding development is the 'Urea-form' type of material which is now being extensively tested agronomically in America. Under controlled conditions, the reaction of urea with

formaldehyde gives a product which is quite slow in solubility and therefore would furnish nitrogen for plant growth at rate satisfactorily required during the growth of crop plants. It is well-known that the superiority of groundnut cake over ammonium sulphate is largely due to its slow availability, so that the nitrogen in the cake becomes available as and when the plants require the nitrogen. The 'urea-form' type functions in similar manner.

In the phosphate field, developments in the method of converting the phosphate rock into a form more available to plants than superphosphate by retarding or preventing the fixation of the phosphate in the soil are in progress. This is quite an important approach. It is well known that so far as phosphates are concerned the 'water soluble form' may not always be the easily available form when applied to the soil as the easy solubility may lead to the rapid fixation of the phosphate in the soil whieh may only be difficultly available later. This has led to a search for techniques by which acidification could be entirely eliminated and this has resulted in the evolutinn of the fusion processes. One such process is the high temperature fusion of the rock phosphate with silica resulting in the production of complex silica-phosphates. This type of phosphate is citrate soluble but not water soluble and field tests with this material in Great Britain have been found to be satisfactory. A factory was working there for a few months during the war in 1945 on this principle but was closed after the war. Work on these lines is in progress in Coimbatore. One handicap of the fusion product however, is reported to be its high alkaline reaction and therefore it is not mixable with ammonium sulphate in the manufacture of fertiliser mixtures. This is supposed to be of disadvantage in the fusion method in countries where fertilisers are largely applied in the form of mixtures. But in India, our farmers do not appear to have any such exclusive preferences in the matter and therefore as a fertiliser. This disadvantage may not be a great impediment in the use of silico-phosphate.

Another line of development in recent times is the improvement in the physical properties of fertiliser materials and also in their nutrient concentration with a view to reducing the bulk. This makes fertilser products more suitable for easy handling, storage and application. Secondly, such processing improvements like 'granulation' offer a chance of reducing the extent of phosphate fixation. This is possibly because, the application in a granular form exposes a lesser surface area per unit weight of fertiliser for soil contact than

the conventional powder form and therefore the chances of fixation are reduced. The efficiency of the phosphate application is increased thereby.

Developments in the production technique have arisen recently consequent on the shortage of essential raw materials employed in the manufacture of fertilisers. A classical example is the shortage of sulphur. This has resulted in new techniques in the manufacture of ammonium sulphate by the use of gypsum as is done in Sindri. Another consequential development arising out of this shortage is in the use of nitric acid in the treatment of phosphate rocks. The basic principle is in the acidulation of phosphate rock with nitric acid or nitric-phosphoric acid and the production of 'nitraphosphates' and this method is being widely advocated in the United States.

Advances in Fertiliser Application: Many advances have come about in recent times in the methods of application of fertilisers to increase their efficiency and also to economise in the quantities applied. This is due to the recognition of the fact that best method of fertiliser application is the one that would allow the crop to secure the nutrients in optimum quantities at the time required by the crop plants and at the places where they would be most effective. The placement of fertilisers near the root zone leads to greater utilisation of fertilisers. Further, smaller applications by placement have been found to produce the same results leading thereby to a greater efficiency and economy in the use of the fertiliser. For example, the application of ammonium sulphate by pelleting and placing the pellets in the reduction zone for paddy crop is reported to halve the requirement of the fertiliser to produce similar results within a certain range. The placement of phosphates is now an accepted practice in phosphate fertiliser application. Apart from reducing the chances of fixation, phosphate placement facilitates better uptake of this nutrient as phosphorous is largely immobile in the soil.

Other advances in application methods relate to the form in which various fertilisers are applied. For example, an important advance in nitrogen application has been the use of anhydrous and liquid ammonia in the direct form. This form carries 82 per cent N and therefore is becoming very popular in some countries for Horticultural crops. In the United States, it is reported that 15 per cent of the total nitrogen application in that country is in this direct form and its use is expanding. Considerable economy attends this form of application and therefore has a great future in India. Another

recent development is in the use of water solutions of ammonium nitrate. Spraying the leaves of fruit trees, specifically apple and citrus with a urea solution resulted in a much more rapid absorption of nitrogen than the conventional soil application. This method of spray application on the foliage is receiving much attention. Pre-treatment of seeds prior to sowing with phosphate solutions has been reported to result in larger crop yields.

Further knowledge in fertiliser behaviour under various conditions of soils and crops by the use of radioisotopes has been gained in recent times, and this bids fair to revolutionise fertiliser application methods or fertiliser use.

Conclusion: This is a changing world. Technogical changes in all fields both agriculture and industry have been breathtaking. When Malthus predicted that world population would out grow its food supply, the scientific aspects of agriculture were unknown. With our present knowledge of plant nutrient behaviour and use, we can falsify the dire Malthusian predicition. New and better bred varieties together with richer fertilisers now enable some farmers in our country to produce a 10,000 lb. paddy crop and a 100 tons sugarcane crop.

Acknowledgment: My thanks are due to Sri. P. A. Venkateswaran, Agronomist and Professor of Agriculture for his critical reading of the text and its revision.

Growing *Calopogonium Mucunoides* as a solution to Soil Erosion on the West Coast

by

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The increasingly devastating effects of uninterrupted soil erosion is perhaps nowhere more patent in this country than in the rolling topography of the South-West Coast of India exposed to an annual rainfall ranging from 100 to 200 inches. While expensive measures of soil conservation like contour bunding, bench terracing etc. are being formulated and carried out under National Plans as well as under the auspices of State Governments separately at very considerable cost, it may sound as fantastic to claim that soil erosion on the slopes of Western Ghats even with over 160 inches of rainfall need cause no concern and involve no expenditure exceeding Rs. 5/- per acre. That the above is neither a miracle nor an exageration would be clear from the following account.

When the Madras Government decided to locate the Central Pepper Research Station at Panniyur on the slopes of the Western Ghats, in Malabar District under the scheme financed jointly by the Madras Government and the Indian Council of Agricultural Research, they were confronted with the problem of conserving the soil on the site comprising gradients ranging up to one in three. Some idea of the extent of soil erosion that was likely in this site measuring 1150 feet from the summit to the foot of the slop and 1100 feet across the slope can be had from the fact that the mean gradient of the site is one in five, that the site is has loosely packed lateritie soil, that the locality enjoys an annual rainfall of over 160 inches and that the catchment area above the site is about 20 acres. The site, after clearence of the tree and scrub jungle growth and removing the stumps and roots and planting *Erythrina indica* standards for training pepper and further digging to remove the subsequent growth from remnants of the original vegetation by November 1952, could not but excite the doubts of almost every visitor as to how it would be possible to stem the rigours of the next monsoon on the newly cleared slopes with its innumerable pockets with sediments snd loose soil, ready to get washed down with the first torrential downpour. This was, in fact, the natural doubt expressed by some of the members of the Spices Enquiry Committee who inspected the site in January 1953.

The picture then and the picture of the site now present such great contrasts that they have to be seen before they can be believed. Some of the illustration (Figs. 1 to 5) in this article would perhaps help the reader to visualise the remarkable and almost astonishing changes that have been effected, all due to the remarkable crop, *Calopogonium mucunoides.*

This plant along with *Pueraria phaseoloides* (Tropical Kudzu) and *Centrosema pubescens* were no doubt well-known to planters to some extent, having been particularly fancied in rubber plantations. The trial of these cover crops on a small-scale in the Research Stations and Farms in Madras State was taken up under instructions from the present Director of Agriculture, Madras in 1947—'48. With the usual chequered career during the early stages of these small-scale trials at numerous centres, the special virtues of *Calopogonium mucunoides* as a cover crop for perennial plantations came to light at the Agricultural Research Station, Ambalavayal, Wynad during 1950, when it was grown over an area of about six acres in mandarian orange orchard. This success inspired the present author with the hope that in *Calopogonium mucunoides* lies the answer to the problem of soil erosion in the Pepper Research Station as well.

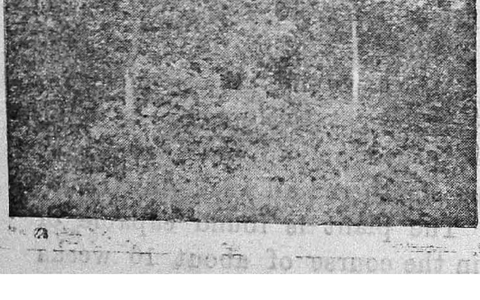
Accordingly with the receipt of light showers early in April 1953, a total quantity of 150 lb of *Calopogonium* seed was broadcast on the entire cleared area of 20 acres. In about three months, by the end of June 1953, when the south-west monsoon began with its usual heavy rains, *Calopogonium* had spread its matting vegetative growth so effectively over the ground, as to leave only the irregular rock outgrowths exposed to the view. The crop seeded profusely and dried up completely by January 1954 leaving a thick mulch of dry leaves over the entire ground. A total quantity of 800 lb of seed was collected, and in spite of this, a very large quantity of seed got dispersed on the ground. With the first rains in the middle of April 1954, the self-sown seeds germinated in profusion. As there was occasional rains in the months of April and May 1954, the plant made very vigorous growth and by the beginning of June 1954 when the south-west monsoon began with very heavy and almost incessant rains, the crop had produced a thick vegetative cover to over the entire gronnd. By the end of July 1954, the crop had made vegetative cover to athickness of nearly 12 inches, smothered all weed growth and covered even the rock outgrowths. The plant is found capable of growing to a length of about 8 feet in the course of about 16 weeks

and to strike root at every one of the nearly 25 nodes over this length, though about 50% of these nodes only actually develop roots in the field. Each plant has three leader shoots and about eight main lateral shoots from each leader shoot. In addition to the large volume of leafy growth over the ground, the plants are found to have developed a large volume of roots in the ground.

1

2

3



In figure 1, a typical vegetative cover produced by *Calopogonium* within about four months of germinating is presented. The picture of a neighbouring private plantation without any cover and the bare ground exposed to soil erosion is presented in figure 2. The mass of leafy growth with fine roots produced from some of the three plants of *Calopogonium* in about four months is presented in figure 3. Thick shade as seen in figure 4 is not found to curb or limit the expanse of *Calopogonium.* Except when sheet rock with no soil whatsoever exists, the plant finds its way and establishes itself though the minutest cracks and crevices. As a means of destruction of weeds, it is patently effective and obviously cheaper than the most effective weedicide known. From figure 1 it will be seen that *Calopogonium* has practically smothered all weed growth including grass growth.

In figure 5, it can be seen how luxuriantly the plant has established itself on a steep embankment. The chief merit of *Calopogonium* as a cover crop, in addition to the ease with which it can be established in a very short period, is that it recedes to the back ground during the summer months, when it dries up, leaving the coast clear to the plantation crop to absorb all the moisture available in the soil. This is a great advantage and as important as the conservation of soil during the heavy beating rains of the South-West monsoon. The role of *Calopogonium* cover crop during summer is not limited to stepping aside for making all the soil moisture available to the plantation crop, as it also providee a protective dry mulch, an invaluable screen against the severe scorching sun in this period. thereby conserving soil moisture through considerably reduced evaporation of soil moisture. It has also another equally important function of enriching the soil by adding an amount of leaf-mould estimated at about 5000 lb. per acre annually.

Tropical Kudzu and *Centrosema* are no doubt valuable vegetative covers in their own way. But, *Calapogonium* has certain superior attributes such as drying up in summer and the ability to cover the ground within the shortest period. Profuse seeding is yet another virtue of *Calopogonium.* This results in the cover crop establishing itself every year with the summer showers from the self-sown seeds. From the foregoing, it will be seen that growing *Calopogonium* is the cheapest and most effective answer to soil erosion in plantations of pepper, orange and coconut on the West Coast, and will in addition act as an effective check against

obnoxious weed growth in these plantations, enrich the soil and conserve the soil moisture.

There are yet other uses for *Calopogonium* on the West Coast. The paddy lands of the West Coast depend primarily, at present, on green leaf collected from the forests and neighbouring vegetation as a source of organic manure. In fact, this together with cattle manure is the main manurial application that the large bulk of paddy area of the West Coast receives. The denudation of the forests as a result of cutting of trees for leaf and fuel has been a long-standing, vexing problem. The needs of the paddy grower as well as the safety of our forest wealth will be met or safeguarded if *Calopogonium* is broadcast on the extensive expanse of the grassy hillocks of the West Coast so that green leaf of this leguminous plant can be available for manuring the paddy fields. Extension of *Calopogonium* to the uncultivated grassy hill slopes is a desirable line of fostering food production at a minimum expenditure of money and energy, in addition to soil conservation on the hill slopes.

Acknowledgement: The author is very thankful to Dr. K. C. Naick, M. Sc., Ph. D. (Bristol), Headquarters Deputy Director of Agriculture (Research), Madras for his valuable help in the preparation of this paper.

Recent advances in Agriculture: Growth Regulators as Weed Killers *

by

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The aim of this paper is to give a comprehensive summary of the various aspects concerned with the use of growth regulators as weed killers.

Growth regulators used as weed killers: The derivatives of following three parent acids of growth regulators have been in vogue as herbicides :—

1. 2, 4 – dichlorophenoxy acetic acid.
2. 2 methyl – 4 – chlorophenoxy acetic acid.
3. 2, 4, 5 – trichlorophenoxy acetic acid.

In recent years, a few more hormone herbicides have been under trial, but are yet to come into as wide a use as the above.

Formulations used: These parent acids are used in the form of acids, salts, esters or amides, and they vary in volatility, solubility and availability. In the use of salts, sodium and ammonium salts are more widely in vogue as they are highly soluble in water. There is also some considerable difference of opinion with regard to the efficacy of these various formulations when used as herbicide. While Zimmerman and Hitchcock (1942) state that salts, esters, and amides are approximately equal in activity to the acid, Hamner *et al* (1947) make a general statement that esters are more effective than acids, and acids are more effective than salts. Taylor (1946) points out that 2, 4 - D acid caused greater inhibition than ammonium salt in certain plants. On the contrary, Ennis and Boyd (1946) after extensive spray treatments on a variety of broad leaved plants showed that the effectiveness of ammonium salt was in no way statistically different from 2, 4 - D acid.

Forms in which they are applied: These substances are applied for control of weeds in the form of sprays, dusts and aerosols. Very recently, the use of these chemicals in pellet forms has also come into practice. In order to make the sprays and dusts as active as possible and give a uniform coverage and distribution, the use of adjuants, wetting agents and carriers is resorted to. Usually

* Paper presented for the College Day and Conference 1954.

polyethylene glycols, like Carbowax 1500 is used as a wetting agent in aqueous sprays; and talc and powdered China clay as carriers for dusts. The preparation of solutions and dusts, and addition of wetting agents and carriers have all been elaborately described by Marth and Mitchell (1944), Carl *et al* (1948), Slade *et al* (1945) and Templeman and Right (1950).

Mode and time of application: Direct foliar applications as well as treatments of soil are being done. The treatments to soils may be made as a preplanting treatment (i. e. before sowing or planting in the soil), or as a pre-emergent treatment (after seeds are sown but before seedlings emerge) or a post-emergent treatment (after seedlings have emerged). Particularly in vegetables and legumes which are susceptible to the direct foliar applications of growth regulators, treatment of soils is resorted to. In all cereals in which the growth regulators can be applied as a direct foliar spray for control of weeds, it is safe to apply after the crops have tillered and upto the *early boot stage:* i. e. when the upper sheath is begining to swell with enlarging head.

Sensitivity of weeds to growth regulators and factors influencing their kill: Many aquatic weeds, broad leaved plants, woody shrubs and vines, and perennials are effectively killed or controlled by growth regulator type of weed killers. Hildebrand (1947). Hitchcock *et al* (1949 and 50), and Jackson (1951) and a host of others have stated that water hyacinth *(Eichornia crassipes)* and other aquatic weeds could be successfully killed by 2, 4-D and allied substances at concentrations raging from 1000 to 3000 parts per million. Destruction of dense woody shrubs, vines and trees by 2, 4-D and other similar substances have been demonstrated by Hamner and Tukey (1945), Tam (1947) and Thimman (1948). Concentrations ranging from 2000 to 10,000 parts per million have been used by them. Hitchcock and Zimmerman (1948), Mitchell and Marth (1948) Zimmerman (1953), and Hemphill (1953) state that many broad leaved plants can successfully be killed at concentrations ranging from 250 to 1000 parts per million. In general, a wide range of weed species are killed by hormone herbicides.

Although many weeds are susceptible to these substances, factors such as weed species, stage of growth, concentration of chemical used, temperature, rainfall etc. govern and influence their herbicidal toxicity. In general, all annuals are susceptible to 2, 4-D, when they are young and actively growing; and resistance increases

with advancing maturity. Perennials are most susceptible when treated at the bud or very early bloom stage, but are altogether less susceptible than the annuals. Temperature and rainfall are the two important factors affecting herbicidal property of these compounds. Tam (1947) reports that temperature ranging from 70° to 85°F through a large percentage of days are highly favourable for the action of 2, 4-D and other hormone herbicides. Marth and Davis (1945), Kelly. Sally (1949) have all shown that warm weather and higher temperature accelerate the herbicidal activity of 2, 4-D. Rainfall has an adverse effect on the herbicidal action value of 2, 4-D and allied substances, and Tam (1947), Thimman (1948), and Weaver et al (1946) have all shown that the rain following the application of 2, 4-D considerably decreases the herbicidal toxicity. As Avery (1947) points out, it is better for maximum effectiveness to apply these herbicides on sunny days in warm weather when weeds are young and actively growing, and rainfall is not expected within 24 hours of application.

General responses of crops to growth regulators: The successful use of growth regulators as herbicides in crops depends on the efficacy of these substances in killing weeds with least or no injury to crops. Crops however vary in their tolerance to growth regulators. In general, broad leaved plants are susceptible to them and members of the grass family are resistant to them. Although cereals in general are tolerant to these herbicides, variation in their responses is being reported. Templeman (1946), and Olson (1952) point out that barley is more liable to damage than either wheat or oat. Variation in the different varieties of the cereals like oat, corn, and sorghum had been observed by Dearbon *et al* (1948), Ellis and Bullard (1948), Derscheid *et al* (1953), and Gassaway *et al* (1952). Dunham (1951) in summarising the responses of plants to 2, 4-D brings out that the differential responses of plants to growth regulators may be attributed to the crop species, variety, dosage, time of application, stage of growth and environment. Mathews (1952) observing the tolerance of plants to growth regulators has classified them into three groups, viz. susceptible, moderately tolerant, and resistant. Legumes without waxy covering, brassicas, tomatoes, sugarbeets, onions, grapes, parsnips, and ornamental plants are generally classed as susceptible; potato, linseed and clover as moderately tolerant, and members of the grass family as resistant. Although vegetables and legumes are susceptible to direct foliar application of herbicides, good weed control without damage to them is possible with soil applications of hormone herbicides. In

fact, Alban and Keirns (1948), Warren (1948), Warren and Hernandez (1948), Havis and Sweet (1948). Danielson (1948), Lachman (1947) and many investigators have demonstrated the possibility of growing vegetables successfully in soils treated with growth regulators and at the same time controlling the weeds in those vegetable plots.

Residual effects on soils: The wide-spread application of hormone herbicides has created an important problem of the persistence of toxicity in soils. The toxicity of growth regulators persists in soils from a few days to several weeks or months depending on the soil condition and environmental factors. Brown and Mitchell (1948), Hernandez and Warren (1950), Jorgenson *et al* (1948), Akamine (1951) and many others have pointed out that factors like soil type, pH, soil moisture, addition of manure, autoclaving, temperature, rainfall and other environmental factors play a vital role in the dissipation of toxicity of these substances. Krishnamurthi and Srinivasan (1954) working on the nature of persistence of toxicity of 2, 4 - D under topical conditions report that sandy soils with a low pH, retain toxicity for a longer time than clayey soils with a high pH value, and have stressed the importance of pH, and soil type on the inactivation of 2, 4 - D toxicity when applied at herbicidal rates to soils. Although it is well known that the growth regulators are inactivated in soil after some time, the exact manner by which it takes place is not yet well understood. Micro-organisms are suggested as a primary factor for the dissipation of toxicity. The effect of growth regulators on micro-organisms, and *vice versa* have been studied to some extent. The action of growth regulators on micro-organisms is negligible but the effect of micro-organisms on growth regulators seems to be of paramount significance. Audus (1951, 52) has amply demonstrated that micro-organisms play a vital role in the dissipation of toxicity of growth regulators.

General progress in other countries with special reference to U. S. A.: Phenomenal progress has taken place in the western countries in the field of weed control by chemicals and the utilisation or hormone herbicides for elimination of weeds has become an established proctice. Particularly in U. S. A., there is a heavy demand for these hormone killers, and the 1951 figures reveal that 112 million pounds of phenoxy acetic acid derivatives alone have been consumed for weed killing purposes. There seems to be no crop or place in which they have not found use. They are used in field

crops, orchards, highways, aquatics and bushy forests. The following is somewhat the general dosage of 2, 4-D and allied substances in U. S. A. for weeding in certain important crops. It should be noted that the time and method of application vary with the crop.

Crop	Dosage employed (pounds per acre)
Corn	¼ to ¾
Sugarcane	2
Wheat, oat & barley	¾ to 2
Flax	1/8 to 1/3
Grasslands	¼ to 3
Orchard Crops :	
(i) Apples, brambles etc.	½ to 2
(ii) Straw berries	2 to 3 (pre-planting treatment)
Vegetables, Legumes etc. :—	
(i) Asparagus, onion & bean	1 to 3 (pre-planting or pre-emergent)
(ii) Potatoes	¼ to ¾
(iii) Peas	½
(iv) Clover	¾
(v) Lucerne	½

Although U. S. A. has made great progress in this field and a vast amount of literature on this subject continues to be published in the States, it should be pointed out that some advances have been made elsewhere too. It can be claimed that Great Britain has all along been in the van of progress in the matter of weed control particularly in grass-land improvement, reclamation of marshland and in other directions with the help of these herbicides, but the utilisation of chemicals in cereals and orchards crop has been somewhat limited. In France, Australia, New Zealand, Italy, Peurto Rico, Hawaii and Japan, the use of these hormone weed killers and other chemical treatments for eradication of weeds has commenced. In Japan, Indonesia and Malaya, 2, 4-D and similar substances are used in rice fields for combating weeds.

In India the work in the field of herbicides is in its infant stage and apart from some preliminary and disconnected trials, very little has been attempted or achieved in an organised systematic

manner. Responses of some annual and aquatic weeds to hormone herbicides have been reported by Kar (1947), Padwick (1948), Thomas and Srinivasan (1949), Joshi *etal* (1950), Imperial Chemical Industries (1951) and Solomon and Rao (1950). Venkatarathnam (1950) has made some gross observations on the nature of responses of some South Indian crops to herbicides. Krishna Rao *etal* (1951) and Thakur (1952) have studied to some extent the effect of 2, 4-D and MCPA on nut grass. For the past two years, in the Department of Agriculture, Annamalai University, some systematic trials, particularly the effect of hormone herbicides on weeds, crops and soils under tropical conditions have been made and some of the results have been published as indicated elsewhere in the body of this paper, and others await publication.

Conclusion: Growth regulators are being widely used in some of the Western countries specially for control of weeds of several kinds viz. aquatic weeds, herbs, shrubs, trees and deep rooted perennials. The growth regulators used for herebicidal purposes, the formulations used, forms in which they are applied, mode and time of application, sensitivity of weeds to growth regulators and factors influencing their kill, general responses of crops to growth regulatiors, and residual effects on soil are all briefly described. The knowledge of behaviour of these substances on weeds, crops and soils is as yet incomplete, and the future work is bound to bridge the gap in our knowledge. However it can be said that one of the recent advances in agriculture is the use of growth regulating substances or plant hormones for herbicidal purposes.

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Media for Mass Cultures of the Ergot Fungus— *Claviceps Purpurea* (Fr.) Tul.

by

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Introduction: The cultures for mass inoculations with *Claviceps purpurea* (Fr.) Tul. are usually grown on sterilized rye grains in ordinary bottles (Hynes 1941; Thomas and Ramakrishnan, 1942). Similar procedure was adopted for the production of cultures on the Nilgiris. But shortage of rye grains during the last two seasons necessitated trials with other grains as media. Husked wheat, barley, oats, ragi and unhusked wheat were under trial. The results of these trials are recorded in this paper.

Materials and methods; The cultures were maintained in bottles. Half a pound of grain was used per bottle. An equivalent volume of water was added and the bottles were autoclaved under 20 pounds pressure for 45 minutes. The wheat used in these experiments was obtained from the Agricultural Researce Station, Siruguppa. Barley, ragi and oats were locally procured. The same isolate of the fungus was used to inoculate the bottles. After inoculation the bottles were kept on the laboratory bench for 2 months and then examined. Two bottles were used for each treatment. In another series 12 grams of jaggery were added to the grains before autoclaving,

Experimental: Periodical observations were made on the growths in the bottles. After the lapse of two months from the date of inoculation the contents of each bottle were stirred into 8 gallons of water and a uniform spore suspension was prepared which was subsequentaly used for spraying the rye crop in flowers. Drops of the above spore suspensions were examined under the microscopic field situated roughly at the centre of the mount under the high power objective. Counts from two mounts were taken in respect of each bottle.

Observations: In the case of husked samba wheat the medium became hard and sticky in consistency after autoclaving thus, making it difficult for the fungus to permeate the medium completely. For eye judgement the growth of the fungus was best in the case of rye, followed by wheat (husked), ragi, barely, wheat (unhusked) and oats in the descending order of merit. Growth was very sparse in the case

of unhusked wheat and oats. There were no observable differences in growth between the two treatments with and without jaggery. The data on the spore counts taken under the microscope in respect of the several treatments are presented in the table below:

Number of spores per field (roughly at the centre of the mount) under the high power objective (x40).

Date of inoculation: 28—8—1950. Date of examination: 28, 29 & 30—10—1950.

Treatment	Without jaggery Number of spores				Average	With jaggery Number of spores				Average
	I	II	III	IV		I	II	III	IV	
Rye	46	35	38	42	40	33	39	37	42	38
Wheat										
,, (husked)	31	26	24	33	29	26	31	27	21	26
,, (unhusked)	9	13	11	8	10	Not tried.				
Barly	10	14	16	11	13	Not tried.				
Oats	9	5	11	7	8	8	5	8	10	7
Ragi	20	14	23	19	19	16	21	23	19	20

Discussion: It will be seen from the table that none of the substitute media tried has proved equal to rye in respect of growth and sporulation. However, during times of need arising out paucity for rye grains, use of husked wheat and ragi grains can be resorted to as an emergency measure and the spore suspension may be prepared using proportionately less quantity of water so as to bring the spore concentration to the same level as in the case of rye media. i. e. about 40 spores per microscopic field under the high power objective, which is the normal concentration adopted for spray inoculation in the fields.

Summary and Conclusion: (1) Among several cereals tried as media for mass culturing of the ergot fungus, rye was found to be the best medium in respect of both growth and sporulation, followed by wheat (husked) ragi, barely, wheat (unhusked) and oats in the descending order of merit.

(2) Addition of jaggery does not induce better growth of sporulation.

(3) In the case of wheat, husking makes a lot of difference and increases sporulation nearly 3 times as compared to unhusked wheat. The effects of husking in the case of other cereals remains to be tested.

This paper was submitted to the First Scientific Workers' Conference held at Coimbatore in 1951 and was discussed in one of

he study group meetings held at the Agricultural College and Research Institute, Coimbatore. In the course of ths discussion Sri M. Sanyasi Raju, Government Agricultural Chemist suggested that malt refuse may also be tried as a medium for mass culturing the ergot fungus. It was replied that the above suggestion will be borne in mind if further studies were to be conducted.

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NEWS AND NOTES

In the Inter Collegiate Debating contest arranged by the Rotary Club at the Y. M. C. A. the Agricultural College was represented by William Odengo Omamo (III Year), Miss Sukenya Bai (III Year) and Mr. Govindarajulu (I Year). Mr. William Odengo Omamo tied for the first place with a Lady Student from Nirmala College.

The students brought out their terminal issue of the "Tatler" this month in an attractive get up with very many interesting articles and photos.

In the field of athletics, the College football team has come up to the finals in the Inter Collegiate tournament, having defeated the P. S. G. College of Technology in the semi-finals by one goal to nil.

The table tennis Intercollegiate tournament was won by the College having won in 5 out of 6 matches played in the tourney.

Research Note

Sowing Groundnut as Pods

In India groundnut is seldom sown as pods. The usual method of sowing is by dibbling well picked kernels behind country plough or drilling with indigenous implements. In America and Philippines groundnut is sometimes sown as pods to eliminate the tedious process of hand shelling. Sowing pods broken into bits, each containing one seed, is also in vogue in some countries but this is possible only with certain vatieties.

No experiment appears to have been conducted so far in India on sowing groundnut af pods. Iu the experimental Stations at Auburn, Alabama ond Georgia in the United States of America trials have shown that sowing of pods results in poor germination and stand resulting in low yields. Sowing groundnut as kernels is therefore recommended. An experiment was carried out at the Agricultural Research Station, Tindivanam to find out the disadvantages of sowing groundnut as podt.

Pods and kernels of TMV 2 (bunch) and TMV 1 (spreading) strains were sown during 1951—'52 rainfed, 1952 irrigated and 1952—'53 rainfed seasons in pots as well as in the field. In pots germination was observed on the fifth day in the case of bunch kernels and seventh day in the case of the spreading kernals. The pods germinated a day later in both the cases. Under field conditions the germination was delayed by one more day in the case of kernels and by two days in the case of pods. The percentage of germination was low in pods by 20 to 30 as compared with the kernels, the spreading variety recording a lower percentage than the bunch variety.

Kerle (1918) has recorded that germination of the kernels from the pods is not simultaneous and takes place one by one. Observations made on this aspect revealed that the "beak-end kernels," which develop later than the "stalk-end kernels," germinated first. Whereas in the bunch pods both the kernels germinate, in the case of the spreading variety the stalk end kernel germinates only in a few cases and even then it failed to grow as it was invariably found attacked by fungus. One hundred two seeded pods of both the bunch and spreading types were sown and tested for germination. It was found that only 69.5% of the kernels in the bunch and 54% of the kernels in the spreading variety grew into seedlings. If optimum moisture conditions were assured for more than ten days after sowing another 25% in case of bunch and 75% in case of spreading variety may sprout, to give double seedlings. The loss of valuable seed materials is the main defect in sowing groundnut as pods.

During 1952—'53 rainfed season, observation plots were laid out to study this problem in greater detail. Bunch and spreading types were sown adopting four treatments, viz., (1) as kernels, (2) as pods, (3) as pod bits — (This is reported to be in vogue in the U. S. A.) and (4) as pods with tip broken — this treatment was given to facilitate good germination. The results are presented in the following table.

Treatment	No. of days taken for germination	Germination percentage	No. of days taken from sowing to 1st flowering	Weight of pods in lb. required to sow an acre	Cost of seed including labour charge	Acre yield of pods in lb.	Percentage on control
TMV 2 (Bunch)							
Kernels	6	87	33	135	39	308	100·0
Pods	8	64	33	200	50	140	45·5
Pods bits	6	84	33	135	38	294	95·5
Pods with tip broken	8	70	38	200	58	227	73·7
TMV 1 (Spreading)							
Kernels	8	74	38	100	30	688	100·0
Pods	10	31	40	150	38	211	30·7
Pods bits	8	62	38	100	31	540	78·5
Pod with tip broken	9	36	40	150	41	201	29·2

The data reveal that germination is low and delayed when sown as pods. Flowering was also delayed by two to five days. Pods with broken tips and pod bits were inferior to kernels in all respects. The yields recorded show that even with increased seed rate (50% more in the case of pods) lower yields are obtained — 25 to 50% less in bunch and upto 70% in spreading type.

In conclusion sowing groundnut as pods results in delayed and poor germination and consequent low yields. The cost of additional seed material required is far more than the charges for hand shelling and picking good kernels. Therefore under conditions obtaining in Madras State, sowing groundnut as pods is not advantageous.

Kerle (1918) - Famer's Bulletin No. 119 - Department of Agriculture, New South Wales. 'Peanut - The unpredictable legume' - A symposium (Book published by the National Fertiliser Association, Washington, United States of America, 1951).

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ABSTRACTS

Insecticides : Derris is compared with other modern chemical insecticides like D. D. T., BHC, Lindane and Toxaphene. Derris is safer than any of these synthetic products. Cats and dogs can be safely treated with it since they are sensitive to D. D. T. etc. Flies though susceptible to D. D. T. and Lindane develop a resistance against these chemical insecticides in which case Derris and Pyrethrum can be used. Before the second world War, Derris—the natural insecticide was used per Helopeltis on Tea and Cocoa, Plutella maculipennis and Crocidolomia hinotalis on cabbage. This was replaced by D. D. T. during the post-war days. These insects having become resistant to D. D. T., Toxaphene, BHC or Derris are recommended for the former while Toxaphene, and Derris are for the latter. Derris when distributed in water and the mixture brushed on the skin of the affected cattle is able to control the warble fly (Hypoderma Spec) much better than any other synthetic insecticide. It has ovicidal action against Orgyia and controls the caterpillar pests of trees such as coliroa. Having residual action it prevents reinfestation of plants.

(Information and Research in 1953 of the Tropical products, Department of the Royal Tropical Institute, Amsterdam, Vol. 25. Page 69—1954) (A. L. D.)

BOOK REVIEW

Book on Weeds in Indian Agriculture by Thakkur : The book on "Weeds in Indian Agriculture" provides interesting reading. The author has attempted to describe some important weeds of Bihar, so that " other investigators of weeds may have something to begin with". The book is divided into two main parts; the first part of eight chapters deals in general with weeds and their control. The second part gives descriptions of a number of local weeds. There is a glossary at the end followed by ready reference to units of weight, capacity and area. A list of references is provided at the end

The author does not seem to be aware of the volume of work that has been carried out in India on weeds and their control. There is no reference either in the text or in the references cited in the end to the hand book of some South Indian weeds by C. Tadulingam and G. V. Narayana wherein, over 40 of the weeds described in the present work have been dealt with in detail. No mention is made of the work on the control of *Eichornia crassipes, Striga spp, Cyperus rotundus or Orobanche cernua* carried out in India by the use of selective weedicides or other methods. In the chapter on biological control of weeds it is stated in the 4th para on page 18 that the method is unknown in India. Evidently the author is not aware of the complete eradication of prickly pear brought about in South India by the introduction of the cochineal insect.

On page 109—110, *Polygala chinensis* is stated to occur in open scrub jungles and grassy grounds and yet deep ploughing and clean cultivation are suggested as control measures. It is presumed that these measures are not to be carried out in the jungles or the grassy grounds. Probably the author does not believe in the maintenance of natural vegetation over wastelands where they may be useful in preventing soil erosion and enriching the soil with organic matter.

Chromosome numbers have been given for several of the weeds but many others whose chromosome numbers are known at present have been left out. The value of the book is not enhanced by the inclusion of these chromosome numbers for some of the weeds.

The book needs thorough revision before it could be placed in the hands of the students.

T. S. R.

GLEANINGS

Compost your phosphatic fertilisers: (C. N. Acharya, Indian Farming IV, p. 9, 1954). Plants absorb phosphates in lesser quantities than they absorb nitrogen. Again, because most soils lack in organic matter and nitrogen greater stress islaid on nitrogen.

But there are areas like Eastern Madhya Predesh or South Bihar and the laterite zones as on the West Coast where the quantity of available phosphorus in the soil is much too small to meet the demands of crops. In such soils a combination of nitrogenous and phosphatic fertilisers gives a much higher yield.

The quantity of available phosphorus in most soils is sufficient to meet the needs of small sized crop, but when a higher level of production is desired the supply of available phosphates becomes much too small and it is necessary to give an extra quantity in the form of fertilisers.

In the case of phosphatic fertilisers the crop is usually able to utilise about 10 to 12 per cent only of the quantity added, the rest being converted into a form not readily available to the plants. Though attempts are made to make phosphates contain in naturally occuring phosphatic fertilisers more soluble by treatment with acid and conversion into super phosphates, the phosphates revert to the insoluble form in the soil. Attempts are being made to get over this by recommending the 'Placement' method of application. This method is applicable mainly for line sown crops but becomes less useful for broadcasted crops and transplanted crops like rice.

Reversion of super phosphate can be reduced by mixing it with 20 to 50 times its weight of compost or farm yard manure before applying it to the field. This is done by spreading Super phosphate powder in thin layers say quarter inch thick over alternate layers of, say six inches, of mixed cattle shed refuse or other compost material. The heap or trench so filled up is allowed to ferment for 4 to 6 months after which the manure is well mixed and applied to the field. Fermentation is quickened and the refuse contains a sufficient amount of available nitrogen in the form of cattle urine or nitrogenous fertilizers. When such composted super is applied the growing crop takes up a greater quantity of phosphorus and yields higher than when phosphate is applied with an equal quantity of cattle shed compost without fermenting the two together.

Experiments show that as with composted super phosphate, composting rock phosphate or bonemeal also gives a higher yield of crops when applied along with nitrogenous fertilisers.

Fisheries Section: *Paddy-cum-Fish culture:* A vast stretch of 37 acres of water-logged area called Arupatha odai in Tanjore district, where deep water paddy is cultivated, reveals scope for tremendous possibilities for fish culture in paddy farms. About 300 acres of paddy area have been selected for experiments on fish culture in paddy farms. The experiments on other plots are frequently subjected to disturbances owing to excess supply of water, due to rain and floods. Intensified stocking has been undertaken for increased production of fish, duly considering the limited period before paddy harvest. The experiments are designed to study in a statistical manner, the results and advantages of fish culture with paddy. Randomisation of species and triplicated system to determine and fix the grade and kind of species suited for culture in paddy fields have been undertaken. The progress is being watched.

Tilapia culture: "Tilapia" fish culture in Tanjore division is done in confined waters under the direct supervision of the Fisheries department. A small quantity of 300 Tilapia of size ranging from 1½ inches to 3 inches was stocked on April 11, 1953 in "Webster moat". The Webster moat is a confined watersheet of 3 acres. Large numbers of carps both fry and fingerlings have also been stocked since then to estimate the productivity of the tank and also to study the comparative results of "Tilapia" culture with carps. Periodical observations have been made and they recorded that Tilapia have multiplied rapidly and the present stock has grown to 12·2 inches in size, weighing 1 lb. and 2 oz. It is an interesting feature to observe that the carps stocked have also shown normal growth. A quantity of 778 lb. of carps was marketed during the last three months. Research on the food, growth and breeding habits of Tilapia is being carried out.

Glyricidia Maculata: Gopalakrishna, N. The Farmer, Vol. V. No. 10, P. 35. 1954. *Glyricidia maculata* is an ideal green manure. It grows in to a medium sized tree and can be cut for manure repeatedly. It grows very quickly and does not deplete the soil much. Propagation is done both by cuttings and seedlings, but the former is better. In the case of the latter, seedlings are raised in the nursery in the first week of June and will be ready for planting in about five weeks. Watering is to be done when necessary. Planting the seedlings can be done in pits 12″ × 12″ × 12″ dug 10 to 15 ft. apart on paddy field bunds. The pits are filled with well decomposed farm yard manure or compost prior to planting. Cuttings can also be planted on bunds with the onset of monsoon. Rooted cuttings are better. Once the seedlings or cuttings are established, very little attention is necessary. During the first year watering is necessary in summer. It is relatively free from pests and diseases.

From the second year of planting, about 30 to 40 lb. of green leaves increasing to 200 to 300 lb. in the 5th year can be got from each tree. If the farmer has about 20 trees, the problem of manuring one acre is solved. Under irrigated conditions leaves can be cut twice a year.

Experiments on Artificial Rain in East Africa: D. H. Davis, *Nature* **174,** 1954. Experiments on artificial stimulation of rain have been conducted in East Africa using finely ground hygroscopic salt (mainly common salt) with a fair degree of success.

Balloons were released whenever large cumulus clouds were present. Five balloons each carrying 15 grams of finely ground hygroscopic particles were released into each cloud. The dispersal was effected by the explosion of a small charge of gunpowder ignited by a time fuse. The length of the fuse was adjusted to cause dispersion just above the base of the cloud. Out of 29 seedings conducted in South Kenya, there was light rain on 16 occasions, heavy rain on one and moderate rain on 2 other occasion and no rain on the rest of the occasions. The interval between the explosion and the deservance of rain ranged from 16 to 38 mts. and the duration of rain 3 to 55 mts. Changes in the colour of the cloud were reported in the vicinity of explosion.

Cloud seeding did stimulate rain on the majority of occasions but such rainfall was generally very light or light. Though there was an increase in total rainfall on days of seeding at a distance downward from the fixed point of release of the seeding agent corresponding to a time interval of about 30 mts. introduction of hygroscopic particles into a large cumulus clouds may produce an immediate interference with the rain producing processes in such clouds and this effect might result in a reduction of rain in the immediate vicinity.

Wheat Harvest Made Easy: Bullock-Drawn Machine Proves Popular: *New Delhi:* A bullock-drawn disk harrow type thresher, known by the name of Olpad thresher is becoming popular with farmers for threshing wheat.

The machine takes half the time required for threshing wheat by the usual method of bullock threshing. Unlike the traditional method it is not fatiguing to work this machine. It also provides the additional weight reguired to get a finer type of *bhusa* and helps to crush the nodes of the straw.

The thresher can be pulled over the ordinary threshing floor by a pair of bullocks. The machine, together with a wooden frame, costs Rs. 150/-.—(For I. C. A. R. Farm News, News Release No. 6)

CROP AND TRADE REPORT

Crop Statistics, 1954—'55 Madras State, Gingelly Intermediate: The condition of the gingelly crop is reported to be generally fair in all districts of the State. Early sown crops have been harvested in the districts of North Arcot and the yield was below normal. The yield per acre of the standing crop is expected to be normal in the districts of North Arcot, Coimbatore and Malabar. It is too early to report on yield of the crop in the districts of Tirunelveli and Ramanathapuram. The wholesale price of gingelly seed per standard maund of 82 2/7 lbs. as reported from important market centres on 13—11—1954 was Rs. 24—8—0 at Tirunelveli, Rs. 22—0—0 at Tuticorin, and Rs. 20—0—0 at Cuddalore and Salem. Compared with the prices that prevailed in the corresponding period of last year, these prices reveal a decrease of 33·8% in Salem, 30·2% in Tuticorin, 30·0% in Tirunelveli and 28·6% in Cuddalore.

Early Sowing is Beneficial for Summer Cotton: The major area under summer cotton in the Madras State is found in Srivilliputtur taluk, where it often succeeds a paddy crop raised with the aid of irrigation from wells or tanks. The transplanting or broadcasting of paddy crop in this area is prolonged from September to the middle of November even, depending upon the onset of North East Monsoon filling up of tanks, availability of other irrigation facilities etc. Consequently the sowing of succeeding cotton crop is also delayed to a considerable extent due to delay in paddy harvest and subsequent preparation of the land for cotton. The figures presented in the following table give the mean yield and fibre properties of cotton raised during three sowing dates during the years 1952—1954 at Srivilliputtur with the two improved Cotton strains existing in the tract :

Sowing Period : I Period — I Week of March.
II Period — IV Week of March.
III Period — I Week of March.

Strain	Sowing period	Means for three seasons (1952—'54)				
		Yield of kapas lb/acre	Ginning %	Fibre length (inch)	Fibre weight (millionth of a gm. per cm.)	% Mature Fibres
MCU 1	I Period	1343	32	1 02	1·44	60
	II ,,	787	32	1·02	1·29	52
	III ,,	455	31	0 97	1·20	22
MCU 2	I Period	1366	33	1·04	1·39	61
	II ,,	694	31	1·03	1·21	47
	III ;,	518	31	1·00	1·05	22

It would be clear from the table that the first sowing period (i. e. crop sown during I week of March) register not only the highest mean yield per acre, but also records the best fibre properties, consistently in both the strains. Hence from the point of view of quantity and quality of harvests also (since Summer cotton from this zone has the reputation of bringing the best quality cotton in the Indian Union at present) it is very necessary that *early sowing of Summer cotton are adopted by all ryots.* This would require not only the early planting of the previous paddy crop but also timely and expeditious preparation of lands for cotton.

(Agricultural News letter, December 1954.)

Weather Review — For the month of November, 1954.

RAINFALL DATA (IN INCHES)

Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January
North	Madras (Meenambakkam)	1·2	— 12 8	35·9
	Tirurkuppam*	0·1	— 9·3	32·9
	Vellore	0·1	— 7·6	26·8
	Gudiyatham*	Nil	— 4·0	37·4
East Coast	Palur*	1·6	— 10·6	41·4
	Tindivanam*	Nil	— 7 2	39·8
	Cuddalore	1·1	— 14·4	47·0
	Nagapattinam	5·5	— 12·0	37·5
	Aduturai*	1·6	— 8 6	36·4
	Pattukottai*	2 0	— 6 5	52·4
Central	Salem	Nil	— 3·8	36·3
	Coimbatore (A. M. O.)*	1·0	— 2·4	25·3
	Coimbatore	3·1	— 0·9	30·1
	Tiruchirapalli	0·7	— 6·3	35·1

Division	Station	Total for the month	Departure from normal	Total since 1st January
South	Madurai	2·1	— 3·6	38·1
	Pamban	4·0	— 7·7	27·3
	Koilpatti*	2·2	— 3·9	33·7
	Palayamcottai	1·3	— 6·1	19·6
	Ambasamudram*	2·7	— 7·3	31·2
West Coast	Trivandrum	0·7	— 6·3	60·8
	Fort Cochin	2·3	— 4·4	115·1
	Kozhikode	2·5	— 4·9	144·8
	Pattambi*	1·1	— 2·8	93·0
	Taliparamba*	0·1	— 3 6	156·3
	Wynaad*	0·1	— 3·9	87·1
	Nileshwar*	Nil	— 3·0	177·3
	Pilicode*	Nil	— 3 1	167·1
	Mangalore	0·3	— 3·6	148·9
	Kankanady*	0·3	— 2·2	149·2
Hills	Kodaikanal	1·7	— 8·5	52·1
	Coonoor*	1·6	— 12·2	49·0
	Ootacamund*	0·5	— 3 8	37·2
	Nanjanad*	0·7	— 3·3	56·9

Note:—1. * Meteorological Stations of the Madras Agric. Dept.

The month began with a feeble western disturbance, affecting Baluchistan and Upper Sind. The first three days passed off without any large change in the weather conditions. On 4—11—1954 maritime air spread over the Peninsula, South of latitude 13° North, and rains were fairly widespread in South Tamilnad and Malabar - South Kanara. On the next day an active convergence zone lay off the Coromandel Coast Two days hence maritime air was found confined only to the South of Latitude 8° North. On 9—11—'54 a feeble incursion of moisture took place over South Rajasthan. In the succeeding eight days there were a number of mild western disturbances. The zone of convergence over Tamilnad extended at 5000 feet above sea level from Madras to Cochin on 18—11—54. Rains were fairly widespread in South Tamilnad and localised in Travancore-Cochin in the succeeding two days. Except a few minor western disturbances there was nothing worth recording in regard to the weather conditions in the remaining portion of the month.

As regards the performance of the North-East monsoon in the Madras State, it is to be recorded that it is far from being satisfactory throughout the State. In certain districts like Chingleput, North Arcot, Tanjore, Tiruchirapalli, Ramanathapuram and Tirunelveli the retreating monsoon was a miserable failure. The crops suffer due to want of rains. The minor irrigation sources have failed with the result that acute difficulty is being felt to irrigate the crops.

The note-worthy rainfalls and the zonal rainfall for the month are furnished here-under:

Note-worthy Rainfalls			Zonal Rainfall			
Date	Name of Place	Rain-fall	Name of Zone	Av. rainfall for Nov.	Dep. from normal	Remarks
2/11/54	Tuticorin	1·5	North	0·4	— 8·4	Far Below normal
3/11/54	Cochin (Wellingdon Island)	3·0	East Coast	2·0	— 9·9	do.
do.	Kozhikode	2·0	Central	1·2	— 3·4	do.
4/11/54	Coimbatore	3·0	South	2·5	— 5·7	do.
do.	Mathurai	1·5	West Coast	0·7	— 3·8	do.
5/11/54	Madras (Nungambakkam)	2·0	Hills	1·1	— 7·0	do.
8/11/54	Alleppey	2·0				
18/11/54	Nagapattinam	1·5				

Agricultural Meteorology Section,
Lawley Road P. O.,
Coimbatore. } C. B. M. & M. V. J.

DEPARTMENTAL NOTIFICATIONS

Gazetted Service — Postings and Transfers

Name and present post	Posted as
Daniel, F. L., Asst. Chemist, Coimbatore,	Compost Dev. Officer, Madras.
Francis, T. S., Asst. Mark. Officer, Coimbatore,	Regl. Dy. Director of Agriculture, Madurai.
Govinda Kurup, K., Addl. D. A. O., Trichy,	A. D., Manjeri.
Thomas, K. G., Addl. D. A. O., Tanjore,	D. A. O., Madurai.
Krishnamurthy, R., Addl. D. A. O., Madurai,	Agronomist, A. R. S., Satyamangalam.
Mohamad Abbas, U. B., (On leave)	Asst. Marketing Officer, Coimbatore.

Upper Subordinates — Postings and Transfers

Name and present post	Posted as
Annaswami, N., S. D. A., Musiri,	A. D., Varagoor.
Anandam Pillai, S., A. D., Melur,	A. D., Dindigul.
Abdul Latheef, A. D., Kollegal,	A. D., Rajapalayam.
Allagappa Pillai, S. A. D., Ramnad,	A. D., Sathangulam.
Annaswami, S., S. D. A., Tinnevelly,	A. D., Kadambur.
Anantachari, P. S., S. D. A., Vellore,	A. D., Perungathoor.
Avudaynayagam, Spl. A. D., Orthanad,	A. D., Thethurai.
Arumugam, M., Spl. A. D., Shiyali,	A. D., Pernamallur.
Achuthan, V., A. D., Allathur,	A. D., Tirur.
AnanthaLrayanan, A. D., Gudalur,	Fruit Asst. Coonoor.
Abubucker, D., Gandhigram,	A. D., Arkonam.
Balasubramaniam, K. M., Asst. in Paddy, Mangalore,	Asst. in Paddy, Coimbatore.
Balasubramaniam, R., P. P. A., Madurai,	Asst. in Vegetables, Coimbatore.
Chami, A., A. D., Srivelliputhoor,	A. D., Ilayangudi.
Choudappa, S. R., Spl. A. D., Peravurni,	A. D., Uthukuli.
Davidar, J. S. C., Spl. A. D., Guindy,	A. D., Poonamalli.
Dorairaj Ratnam, Spl. A. D., Tinnevelly,	A. D., Devipatnam.
Doraiswami, G., A. D., Gobi,	A. D., Bhavani.
Doraiswami, R., A. D., Bhavani,	Exten. Officer, in Agriculture, Salem.
Elumalai, T., Spl. A. D., Guindy,	A. D., Perambakam.
Edwin Amirtharaj, A. D., Palni,	A. D., Theni.
Ernest, R. S., A. D., Tirupur,	A. D., Sulur.
Fernandez, A., S. D. A., Koilpatti,	A. D., Melapattam.
Govindaswami, T. N., A. A. D., Sathiathope,	A. D., Ulandurpet.
Gobinath, M., S. D. A., Palghat,	A. D., Ginlandy.
Gopalakrishnan, K., A. D., Palghat,	A. D., Choughat.
Govindarajan, Paddy Asst. Palur,	A. A. D., Panruti.
Gopalakrishnan, K., A. A. D., Buntwal,	Botany Asst., Coimbatore.
Ganapathy, T., Spl. A. D., Tirupur,	Spl. Asst., Udumalpet.
Herald Vedanayagam, Spl. A. D., Tanjore,	A. D., Mudukalathur.
Hariharan, S. V., A. D., Ambasamudram,	A. D., Trichengode.
Haridass Menon, Spl. A. D., Nannilam,	A. D., Palakode.
John Thiruthuvaraj, A. A. D., Srirangam,	A. D., Karaiyur.
Jagath Chander Shetty, A. D., Coondapur,	A. D., Kollegal.
John Knight, A. D., Walajah,	Fruit Asst., Thimmapuram.
Joseph, J. B., A. D., Dindigal,	A. D., Natchiarkoil.
Krishnamurthy, P. S., A. D., Tiruvellore,	A. D., Oothukottai.
Krishnan, S., A. A. D., Sholavandan,	A. D., Natham North.
Kollappa Pillai, S., Spl. A. D., Melur,	A. D., Abiramam.
Karupanan, P. M., A. D., Salem,	A. D., Vilathikulam.

Name and present post	Posted as
Kannan, S. D. A., Salem,	A. D., Uthankarai.
Kuppuswami, V. N., A. A. D., Vellur,	A. D., Puduchatram.
Kunhi Mohd, Exten. Officer, Payanur,	A. D., Kozhikode.
Kuriakose, T., A. D., Perintalmana,	A. D., Mannarghat.
Kuttisankaran, M. P., A. F. M., Kulitalai,	A. D., Nambiur.
Kolandaiswami, S. A. D., Pudukottai,	Exten. Officer in Agrl., Trichy.
Krishnankutti, K. S., A. D., Choughat,	do. Malabar.
Krishnaswami Sarma, M. C., F. M., Central Farm, Coimbatore,	F. M., Satyamangalam.
Kannan Nambiar, P., P. A. to D. A. O., Tellichery,	A. D., Cananoor.
Mohd Fathauddin, A. A. D., Rajapalayam,	A. D., Gummidipundi.
Mohd Habeeb, S. B., A. D., Musiri,	A. D., Manigandam.
Mahoob Alikhan, Spl. A. D., Kanur,	A. D., Aravakurichi.
Mahadevan, A. A. D., Thandigudi,	A. D., Keeranur.
Mukundan, T. K., S. D. A., Shoranur,	A. D., Pattambi.
Matthews, V. G., A. A. D., Kalpetah,	A. D., Cheyyur.
Manimanthri, C., A. D., Trichengode,	Exten. Officer in Agrl., Tirunelvely.
Mukta, M., Asst. in Tuber, Mangalore,	Asst., in Paddy, Tirurkuppam.
Moosa Berami, A. D., Khozhikode,	Exten. Officer in Agrl., Payanur.
Muddappa Gowda, P., S. D. A. Gobi,	do. Ramapuram.
Mahadevan Piliai, A. A. D., Vedasandur,	Cotton Asst., Koilpatty.
Nanjayan, K., A. D., Tirukoilur,	A. D., Melalokur.
Narayana Nambiar, P. K., Spl. A. D., Lalgudi,	A. D., Thirumalavadi.
Natarajan, C. T., Spl. A. D., Kulitalai,	A. D., Nirpalani.
Nagarajan, S. S., A. D., Athur,	A. D., Keelamangalam.
Narayana Nambisan, Spl. A. D., Sholavandan,	A. D., Mettur.
Narayanan, A., A. D., Ramanathakara,	A. D., Taliparamba.
Narayanankutty, K. G., A. D., Tellicherry,	A. D., Kunnamangalam.
Narayanan, C. K., Spl. A. D., Tiruturaipundi,	A. D., Peravurni.
Perumal, A. S., A. D., Sankarankoil,	A. D., Tuticorin.
Ponniah, S., Spl. A. D., Tirunelvely,	A. D., Radhapuram.
Pattathan, A. D., Kasarkode,	A. D., Puthoor.
Pattabhi Raman, A., A. D., Perundurai,	A. D., Kodumudi.
Padmanabhan Nambiar, A. D., Cannanoor,	A. D., Melapattam.
Radhakrishna Reddy, A., A. D., Saidapet,	A. D., Villivakkam.
Rangaramanujam, N. A., A. D., Panruti,	Exten. Officer in Agrl. Chingleput.
Ramadurai, C. N., Spl. A. D., Cuddalore,	A. D., Penadam.
Rathinasabapathy, A. D., Pudukottai, East,	A. D., Pudukottai.

Name and present post	Posted as
Radhakrishnan, M., Spl. A. D., Uthamapalayam,	A. D., Keeranur.
Ranganathan, A. K., Spl. A. D., Trichy,	A. D., Kananoor.
Ranganathan, P., A. A. D., Othakadai,	A. D., Palamedu.
Ramaswami, P. C., Spl. A. D., Tirunelvelly,	A. D., Thirupuvanam.
Ramakrishnan, M. S., Spl. A. D., Ambasamudram,	A. D., Vijayanarayanan.
Rajamanickam, S., A. A. D., Katpadi,	A. D., Vaniambady.
Ranganathan, C., Spl. A. D., Kumbakonam,	A. D., Thandarampet.
Rangaswami Reddy, S., A. D., Srivaikuntam,	A. D., Salem.
Ramachandra Poduval, A. A. D., Shoranur,	A. D., Thiruvengadi.
Ramakrishna Sarma, V., A. A. D., Belthangudi,	A. D., Kasargode.
Ramanathan, A. D., Madras,	Exten. Officer in Agri. Chingleput.
Ramadass, A. A. D., Periapalayam,	Exten. Officer in Agri. N. Arcot.
Ramakrishnan, S., A. D., Nathan,	do. do. Coimbatore.
Raghu Shetty, A. D., Kasarkode,	do. do. S. Kanara.
Raman, K. R., Fruit Asst., Thimmapuram,	Fruit Asst., Periakulam.
Ramaratnam, R., A. D., Vegetables,	A. D., Saidapet.
Ramachandra Marar, Lec. in Agrl.	A. D., Ootacamund.
Rajan, M., Spl. A. D., Pattukottai,	Exten. Officer in Agrl. Gudimangalam
Radhakrishnan, T. V., C. C., Inspector, Sankarankoil,	A. D., Udamalpet.
Sampath, V., Fruit Asst., Kallar,	Govt., Garden, Ootacamund.
Sivasubramaniam, S. D. A., Guindy,	Exten. Officer in Agri., Chingleput.
Sundararajan, M. S., A. A. D., Thirukazhukundram,	A. D., Thiruporur.
Shanmugam, C. T., A. D., Chingleput,	A. D., Madurantakam.
Sryan Kumaran, S., A. D., Kallakurichi,	A. D., Rishivandyam.
Solayappan, B., A. D., Chidambaram,	A. D., Kumarakshi.
Soundararajan, R., A. A. D., Thuraiyur,	A. D., Thirumayam.
Sivasubramaniam, P. K., S. D. A., Trichy,	A. D., Alangudi.
Somayan, J. B., A. D., Natchiarkoil,	A. D., Palni.
Seshadri, P., Spl. A. D., Madurai,	A. D., Ramanathapuram.
Somasundaram Pillai, K., A. A. D., Virudhunagar,	A. D., Reddipatti.
Shoukat Ali, S. D. A., Sathur,	A. D., Karaikudi.
Shanmugavelu, B., Spl. A. D., Madurai,	A. D., Peravur.
Sivaramakrishnan, N., A. A. D., Cheranmadevi,	A. D., Srivaikuntam.
Subramaniam, T. N., A. D., Chengam,	A. D., Arcot.
Srinivasan, N. R., Exten., Officer in Agri. Ooty,	A. D., Chengam.

Name and present post	Posted as
Sundararajan, S., Spl., A. D., Tanjore,	A. D., Kunnathur.
Shanmugam, S. P., Spl. A. D., Mayavaram,	A. D., Mandakolathur.
Sivaraman Nair, P. C., Spl. A. D., Papanasam,	A. D., Pernambut.
Selvaraj Carvelho, A. D., Krishnagiri,	A. D., Sangaree.
Sheenappa, K., A. D., Mangalore,	A. D., Coondapur.
Sadasiva Shetty, Y., A. D., Karkad,	A. D., Belthangudi.
Sundaram Pillai, K., A. D., Erode,	A. D., Andhiyur.
Swaminathan, S., Spl. A. D., Tiruvarur,	A. D., Mulanur.
Subramaniam, C. P., A. D., Ponneri,	A. D., Madukarai.
Srinivasan, V., A. D., Kotagiri,	Exten. Officer, in Agri., Ooty.
Sathruddin, A. D., Mudukalathur,	do. do. Ramnad.
Sankaranarayanan, R., Asst., in Paddy, Tirurkuppam,	Asst., in Paddy, Polur.
Subbiah Pillai, R., A. D., Arkonam,	Supervisor, Rasipuram.
Shanmugam, N. Myco., Asst., Coimbatore,	P. P. A., Madurai.
Sankaranarayanan, C., S. D. A., Coimbatore,	Exten. Officer in Agrl., Kinathukadavu.
Subbaya, K. K., A. D., Peravurni,	Ento. Asst., Coimbatore.
Thejamurthy, P. S., (On leave),	A. D., Mailam.
Tanikachalam, T. K., A. D., (On leave),	A. D., Tirukoilur.
Thirumaleshwar Bhatt, N., S. D. A., Mangalore,	Mycol. Asst., Coimbatore.
Thirunavakarasu, R., A. A. D., Arasampatti,	A. D., Paramathi.
Vrishabadass, P., A. A. D., Sankarapuram	A. D., Pakkam.
Venkatachalam, T., Spl. A. D., Musiri,	A. D., Peruvelapur.
Velayudam, A. D., Nilakottai,	A. D., Jayamkondan.
Veeraraghavan, P. P. A., Madurai,	A. D., Vedasandur.
Vasudevan, K. V., Spl. A. D., Tanjore,	A. D., Barur.
Venkataraman, T. M., Fruit Asst., Periakulam,	A. D., Walajah.
Varadarajan, E. N., A. D., Avanasi,	Fruit Asst., Mettupalayam.
Venugopal, Spl. A. D., Udumalpet,	A. D., Sulur.
Usmankhan Ghori, Spl. A. D., Madurai,	A. D., Mettur.
William, P., A. D., Ooty,	Exten. Officer in Agri., Nilgiris.